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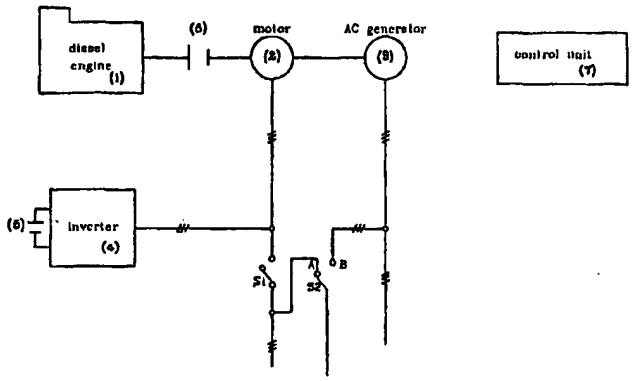

(57) Abstract

This invention is concerning a new concept of alternating current (AC) uninterruptible power supply (UPS) without an autonomy limit. The power supply comprises a diesel engine (1), an asynchronous motor (2), an AC generator (3), an inverter (or a direct current (DC) to alternating current (AC) -DC to AC- converter) (4), a small battery (5) and a free wheel clutch (6). The system is intended to provide power to an AC distribution network without any interruption. This purpose is achieved as follows: when the mains power is available it is driving the asynchronous motor which, in turn, drives the AC generator. The load network is isolated from the mains by the two electrical machines (2 and 3), and the remaining components of the system are idle; when mains fails the inverter (4) drives the asynchronous motor (2) using the battery (5) power and keeping the AC generator (3) running. Meanwhile the diesel engine (1) starts, engages the free wheel clutch (6) and drives the common axis of the two electrical machines (2 and 3), to take over the load. The inverter (4) is switched off; when mains returns the asynchronous motor (2) is driven again and the diesel engine (1) is stopped. The system also includes a set of switches (S1 and S2) that switch on and off the equipment input and output, and an overall control unit (7). This system is intended to provide power supply to the electrical distribution network in buildings and installations where any interruption of AC power is not allowed, such as data processing centers, hospitals, airports, continuous operation industrial processes and other public buildings.

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DESCRIPTION

HYBRID ALTERNATING CURRENT UNINTERRUPTIBLE POWER SUPPLY

Introduction

Static uninterruptible power supplies (UPS) present an important drawback - the energy is supplied to the user network for a short period of only 5 to 20 minutes because of the batteries energy storage limited capacity. When power supply is required for longer mains failure periods there is a need to use a diesel motor generator group in series with the static UPS to avoid the interruption of energy supply during the engine start time, and to isolate the user network from voltage surges and pulses - and other mains perturbations. This association of a diesel generator together with a static UPS is expensive and bulky.

There is a number of manufacturers that offer UPS solutions with a diesel engine together with electrical machines. The known solutions are:

- an association of diesel engine, AC generator, synchronous motor and a kinetic energy storage device, usually a large and heavy flywheel;
- an association of a diesel engine and complex "multiple rotor" electrical machines;
- an association of a diesel engine, an AC generator and a static UPS.

These solutions are bulky and expensive and they present some technical drawbacks. The system under consideration is different. It is an association of a standard diesel engine, an asynchronous electrical machine, an AC generator, an electronic DC/AC converter, a small battery and a free wheel clutch.

System Structure

In order to provide a better clarification of the present invention, a drawing sheet, where the main components of the system are shown, is annexed to this description. The mechanical connection between the diesel engine and the AC motor is made trough a free wheel clutch, thus allowing the AC generator to rotate while the diesel engine is idle. The AC generator and the asynchronous motor share the same axle. The motor is normally mains powered. When mains fails the motor is supplied from a lead acid battery through the DC/AC converter.

Operation Principles

The system has three operating modes:

a) Normal operation: when mains is present;

b) Diesel engine start and transfer mode, immediately after mains failure;

c) Emergency operation: when mains is not present and the diesel engine drives the AC generator.

On normal operation mode the diesel engine is stopped and the DC/AC converter is switched off. The electrical motor is supplied from mains and drives the AC generator, which supplies energy to the user. The user is electrically isolated from the mains. The user electrical current harmonic distortion and power factor have no consequences on the mains. Due to the electrical motor slip the AC generator frequency is about 0.5% less than the mains frequency. In order to avoid a wide frequency slip the nominal power of the electrical motor is 20% to 100% larger than the AC generator rated power.

An auxilliary battery charger keeps both batteries fully charged (the diesel engine start up battery and the DC/AC converter battery). An electronic control circuit monitors the mains voltage and frequency, in order to switch the system into the diesel start and transfer mode b), whenever the mains fails or exhibits significant perturbations. The DC/AC converter power circuits are switched off, but the control circuit is in permanent operation, thus keeping permanent synchronism with the mains.

On a mains failure event the DC/AC converter power circuits are activated and S1 switch connects the output of the DC/AC converter to the electrical motor. The kinetic energy of the electrical machines is enough to keep them rotating, and to maintain the output voltage and frequency, during S1 change over time. The DC/AC converter drives the electrical motor for a short time interval (less than 1 minute). Meanwhile, the diesel engine starts and reaches the electrical machines rotating speed. At that point the free wheel clutch is operated and the power torque is transferred from the electrical motor to the diesel engine. The system is in emergency operation mode c).

On emergency operation the DC/AC converter remains switched off and the batteries are charged. When the mains voltage and frequency return to their normal operating limits, the control circuit brings S1 back to the normal operation mode setting.

The DC/AC converter is operative for only a short period (1 minute at the maximum); a full bridge, square wave, inverter thermally designed for a short operating period is enough. The battery capacity is also very small when compared against conventional UPS batteries.

An additional option in this system is an emergency output. When the user also requires an emergency output with a standard diesel engine/AC generator group (short power break, automatic change over from mains to AC generator), the AC generator and the diesel engine are power rated to the total required power and the electrical motor is dimensioned to twice the UPS required power. As a result, the system as two outputs:

- a no break mains isolated output;
- an emergency output, with a short break after mains failure.

S2 switch is normally switched to A and the user emergency circuit is connected to the mains. When the diesel engine starts up S2 is switched to B and connects the user emergency circuit to the AC generator.

The UPS and the emergency output power rates are almost independent. However, mechanical constraints concerning the axles sizes limit the minimum UPS power to about half the total output power.

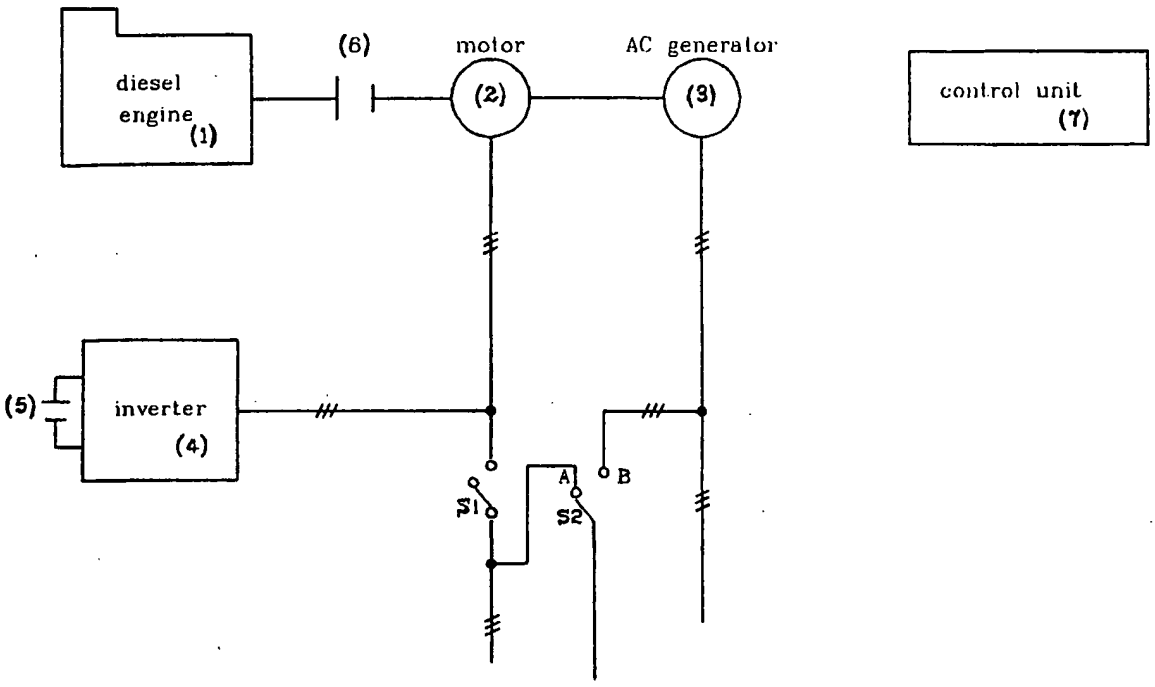
CLAIMS

1. Uninterruptible alternating current power supply with the characteristic of being achieved by the association of the following industry standard machines: one AC generator, one asynchronous motor, one diesel engine and one free wheel clutch - with one electronic power inverter (DC\AC converter).

2. Uninterruptible alternating current power supply as described in claim one, with the characteristic of using a static power inverter, just for the time required for the diesel engine to start up and to take over the load.

3. Uninterruptible alternating current power supply as described in claims one and two, with the characteristic that the asynchronous motor is oversized in order to reduce the frequency slip in order to keep the output frequency close to the nominal value.

4. Uninterruptible alternating current power supply as described in claims one, two and three, with the characteristic that it can have an additional output, not isolated from the mains, where a short interruption occurs when the mains fails.


diesel engine (1)
(6)
motor (2)
AC generator (3)
control unit (7)
(5)
inverter (4)
S1
S2
A
B

INTERNATIONAL SEARCH REPORT

Int 'tional Application No
PCT/PT 94/00012

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02J9/08 H02J9/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	REVUE GENERALE DE L'ELECTRICITE, no.11, December 1992, PARIS FR pages 33 - 38 BOLLINGER ET AL 'groupes électrogènes 'no-break' pour reseau de haute qualité' see the whole document ---	1,2,4
A	DE,A,31 38 894 (SIEMENS) 14 April 1983 see page 6, line 19 - page 18, line 7; figures 1-4 --- -/--	1,3

[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
31 January 1995	10.02.95

Name and mailing address of the ISA	Authorized officer
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A	WO,A,85 01021 (POWER GROUP INTERNATIONAL CORPORATION) 14 March 1985 see page 6, line 1 - page 13, line 16; figure 1 ---	1
A	COMPUTER TECHNOLOGY REVIEW., vol.9, no.16, January 1990, LOS ANGELES US pages 107 - 111 LENGEFELD 'rotary ups-more reliable for new computers' see the whole document -----	

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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		AU-B-	560119	26-03-87
		AU-A-	2960184	29-03-85
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